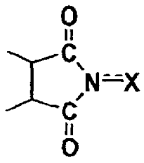
CLAIMS

1. A process for separating a reaction product and an imide compound from a reaction mixture obtained by reacting a substrate in the presence of the imide compound having an imide unit represented by the following formula (1):



(1)

wherein X represents an oxygen atom, a hydroxyl group or an acyloxy group,

which comprises :

(A1) a solvent-crystallization step for crystallizing the imide compound with at least one solvent selected from the group consisting of a hydrocarbon, a chain ether and water,

(A2) a cooling-crystallization step for crystallizing the reaction product by cooling, or

(B) an extraction step for distributing the reaction product into a phase of a water-insoluble solvent and the imide compound into a phase of an aqueous solvent, respectively by using the aqueous solvent containing at least water and the water-insoluble solvent separable from the aqueous solvent.

2. A separating process according to claim 1,

wherein, in the solvent-crystallization step (A1), the hydrocarbon is an aliphatic hydrocarbon having 4 to 16 carbon atoms or an alicyclic hydrocarbon having 4 to 16 carbon atoms, and the chain ether is a diC_{1-6}alkyl ether or a C_{1-6}alkyl C_{6-10}aryl ether.

3. A separating process according to claim 1, wherein the imide compound is an aromatic imide compound, and the reaction product is an oxidation reaction product of an alicyclic hydrocarbon or an alicyclic alcohol and is soluble in the solvent for crystallization in the solvent-crystallization step (A1).

4. A separating process according to claim 1, wherein, a solvent which is a poor solvent for the reaction product and is a good solvent for the imide compound is used as a reaction solvent in the cooling-crystallization step (A2).

5. A separating process according to claim 1, wherein a C_{1-4}carboxylic acid, a C_{1-10}alcohol or a water-containing solvent is used as a reaction solvent in the cooling-crystallization step (A2).

6. A separating process according to claim 1, wherein the reaction product is an oxidation reaction product of an alicyclic hydrocarbon or a methyl group-containing aromatic compound in the cooling-crystallization step (A2).

7. A separating process according to claim 1, wherein the imide compound is an aromatic imide compound

and the reaction product is an aliphatic carboxylic acid having 6 or more carbon atoms or an aromatic carboxylic acid in the cooling-crystallization step (A2).

8. A separating process according to claim 1, wherein, in the extraction step (B), the aqueous solvent is water.

9. A separating process according to claim 1, wherein, in the extraction step (B), the aqueous solvent contains a base.

10. A separating process according to claim 1, wherein in the extraction step (B), the reaction mixture is subjected to hydrolysis treatment in advance of separation of the reaction product and the imide compound.

11. A separating process according to claim 10, wherein the reaction mixture is hydrolyzed by using an aqueous solvent containing a base.

12. A separating process according to claim 1, wherein, in the extraction step (B), the water-insoluble solvent is at least one member selected from the group consisting of a hydrocarbon and an ether.

13. A separating process according to claim 1, wherein the water-insoluble solvent is used as a reaction solvent in the extraction step (B).

14. A separating process according to claim 1, wherein the reaction product is an oxidation reaction product of an alicyclic hydrocarbon, or an aromatic hydrocarbon having a methyl or methylene group, and is

water-insoluble in the extraction step (B).

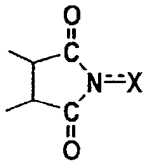
15. A separating process according to claim 1, wherein the reaction product is a cyclic alcohol, a cyclic ketone, an aldehyde having a cyclic hydrocarbon group or a carboxylic acid having a cyclic hydrocarbon group in the extraction step (B).

16. A separating process according to claim 1, wherein the reaction is conducted in the presence of a solvent, and the reaction mixture is subjected to a condensation step to separate the solvent in advance of separation of the reaction product and the imide compound.

17. A separating process according to claim 1, wherein the substrate is reacted in the additional presence of a co-catalyst.

18. A separating process according to claim 1, wherein the imide compound is an oxidation catalyst for oxidizing the substrate, and the reaction product is an oxidation reaction product corresponding to the substrate.

19. A process for separating an imide compound and a metal catalyst from a mixture containing the metal catalyst and the imide compound having an imide unit represented by the following formula (1):



(1)

wherein X represents an oxygen atom, a hydroxyl group or an acyloxy group,

which comprises:

(C) a solvent-crystallization step for crystallizing the imide compound by using a solvent for crystallization,

(D) an absorption step for absorbing the metal catalyst by an absorption treatment, or

(E) an extraction step for distributing the imide compound into a phase of a water-insoluble solvent and the metal catalyst into a phase of an aqueous solvent, respectively by using the aqueous solvent containing at least water and the water-insoluble solvent separable from the aqueous solvent.

20. A separating process according to claim 19, wherein, in the solvent-crystallization step (C), the solvent for crystallization is an aqueous solvent.

21. A separating process according to claim 20, wherein, in the solvent-crystallization step (C), the aqueous solvent is water.

22. A separating process according to claim 19, wherein the imide compound is an aromatic imide compound, and the metal catalyst is at least one compound selected from the group consisting of a transition metal element-containing compound and a compound containing a Group 13 element of the Periodic Table of Elements and is soluble in an aqueous solvent in the solvent-crystallization step

(C).

23. A separating process according to claim 19, wherein, in the absorption step (D), the absorption treatment is conducted by using an ion-exchanger.

24. A separating process according to claim 19, wherein the metal catalyst is at least one compound selected from the group consisting of a transition metal element-containing compound and a compound containing a Group 13 element of the Periodic Table of Elements in the absorption step (D).

25. A separating process according to claim 19, wherein, in the extraction step (E), the aqueous solvent is water.

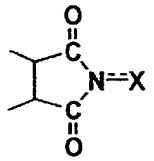
26. A separating process according to claim 19, wherein, in the extraction step (E), the water-insoluble solvent is at least one member selected from the group consisting of a hydrocarbon, an alcohol, a nitrile and a mixed solvent thereof.

27. A separating process according to claim 19, wherein the imide compound is an aromatic imide compound, the metal catalyst is at least one compound selected from the group consisting of a transition metal element-containing compounds and a compound containing a Group 13 element of the Periodic Table of Elements and is water-soluble, the aqueous solvent is water, and the water-insoluble solvent is at least one member selected from the group consisting of a hydrocarbon having 6 or more

carbon atoms, an alcohol having 4 or more carbon atoms, an aromatic nitrile and a mixed solvent thereof in the extraction step (E).

28. A separating process according to claim 19, wherein the imide compound and the metal catalyst are an oxidation catalyst for oxidizing a substrate, and the imide compound and the metal catalyst are separated from a reaction mixture obtained by the oxidation reaction of the substrate.

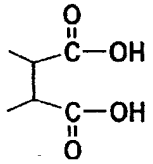
29. A process for regenerating an imide compound having an imide unit represented by the following formula (1):



(1)

wherein X represents an oxygen atom, a hydroxyl group or an acyloxy group,

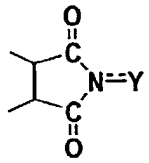
from a deactivated imide compound which is formed by employing the imide compound in a reaction, which comprises hydrolyzing the deactivated imide compound to convert into a dicarboxylic acid or a salt thereof having a unit represented by the following formula (3),



(3)

reacting the dicarboxylic acid or the salt thereof, or a reactive derivative of the dicarboxylic acid with (i) a hydroxylamine or (ii) O-substituted hydroxylamine, and treating with an acid to regenerate the imide compound.

30. A regenerating process according to claim 29, wherein the deactivated imide compound is an imide compound having a unit represented by the following formula (4):

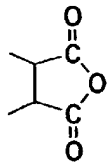


(4)

wherein Y represents a hydrogen atom or an alkoxy group,

or a ring-opened derivative thereof.

31. A regenerating process according to claim 29, wherein the reactive derivative of the dicarboxylic acid having the unit represented by the formula (3) is a cyclic anhydride having a unit represented by the following formula (5).



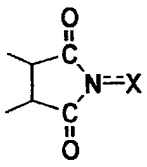
(5)

32. A regenerating process according to claim 29,

wherein the regenerated imide compound is recycled to the reaction system.

33. A process for producing an organic compound, which comprises;

reacting an organic substrate in the presence of an imide compound having an imide unit represented by the following formula (1):

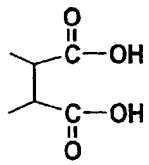


(1)

wherein X represents an oxygen atom, a hydroxyl group or an acyloxy group

separating a reaction product formed in the reaction step and the imide compound,

regenerating the imide compound by hydrolyzing a deactivated imide compound in the reaction step to be converted into a dicarboxylic acid or s salt thereof having a unit represented by the following formula (3),



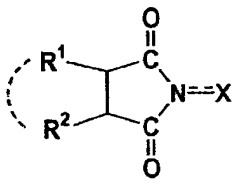
(3)

by reacting the dicarboxylic acid or the salt thereof, or a reactive derivative of the dicarboxylic acid with (i) a hydroxylamine or (ii) an O-substituted

hydroxylamine, and by treating with a acid to regenerate the imide compound, and,

recycling the regenerated imide compound to the reaction step.

34. A process according to any of claim 1, 19 or 29 wherein the imide compound is an imide compound represented by the following formula (2);



(2)

wherein R^1 and R^2 are the same or different, each representing a hydrogen atom, a halogen atom, an alkyl group, an aryl group, a cycloalkyl group, a hydroxyl group, an alkoxy group, a carboxyl group, an alkoxycarbonyl group, or an acyl group; R^1 and R^2 may bond together to form a double bond or an aromatic- or non-aromatic ring; the aromatic- or non-aromatic ring composed of R^1 and R^2 may have at least one imide unit represented by the formula (1); and X has the same meaning as defined above.

35. A process according to claim 34, wherein the imide compound is an aromatic compound wherein R^1 and R^2 may bond together to form an aromatic ring.